

What is claimed is:

1. A method of altering the content or composition of lignin in a plant, comprising:
  - a. transforming plant cells with an isolated DNA comprising a nucleic acid or its complement operably linked in either sense or antisense orientation to at least one regulatory sequence, wherein said nucleic acid comprises a nucleotide sequence coding for (i) *Arabidopsis* C3H comprising an amino acid sequence set forth in SEQ ID NO:4 or SEQ ID NO:6, (ii) mutant c3h comprising an amino acid sequence set forth in SEQ ID NO:5 or SEQ ID NO:7, (iii) a protein comprising an amino acid sequence that has at least 75% identity with an amino acid sequence set forth in SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6 or SEQ ID NO:7 or (iv) *Arabidopsis* C3H polypeptide ortholog, wherein said isolated DNA or fragment thereof is capable of altering lignin content, and
  - b. regenerating said plant from said transformed plant cells.
2. A method of increasing flavonoid content in a plant, comprising:
  - a. transforming plant cells with an isolated DNA comprising a nucleic acid or its complement operably linked in either sense or antisense orientation to at least one regulatory sequence, wherein said nucleic acid comprises a nucleotide sequence coding for (i) *Arabidopsis* C3H comprising an amino acid sequence set forth in SEQ ID NO:4 or SEQ ID NO:6, (ii) mutant c3h comprising an amino acid sequence set forth in SEQ ID NO:5 or SEQ ID NO:7, (iii) a protein comprising an amino acid sequence that has at least 75% identity with an amino acid sequence set forth in SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6 or SEQ ID NO:7 or (iv) *Arabidopsis* C3H polypeptide ortholog, wherein said isolated DNA or fragment thereof is capable of increasing flavonoid content, and
  - b. regenerating said plant from said transformed plant cells.
3. A method of increasing isoflavonoid content in a plant, comprising:
  - a. transforming plant cells with an isolated DNA comprising a nucleic acid or its complement operably linked in either sense or antisense orientation to at least one regulatory sequence, wherein said nucleic acid comprises a nucleotide sequence coding for (i) *Arabidopsis* C3H comprising an amino acid sequence set forth in SEQ ID NO:4 or SEQ ID NO:6, (ii) mutant c3h comprising an amino acid sequence set

forth in SEQ ID NO:5 or SEQ ID NO:7, (iii) a protein comprising an amino acid sequence that has at least 75% identity with an amino acid sequence set forth in SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6 or SEQ ID NO:7 or (iv) *Arabidopsis* C3H polypeptide ortholog, wherein said isolated DNA or fragment thereof is capable of increasing isoflavonoid content, and

- b. regenerating said plant from said transformed plant cells.

4. A method of increasing anthocyanin content of a plant, comprising:

- a. transforming plant cells with an isolated DNA comprising a nucleic acid or its complement operably linked in either sense or antisense orientation to at least one regulatory sequence, wherein said nucleic acid comprises a nucleotide sequence coding for (i) *Arabidopsis* C3H comprising an amino acid sequence set forth in SEQ ID NO:4 or SEQ ID NO:6, (ii) mutant c3h comprising an amino acid sequence set forth in SEQ ID NO:5 or SEQ ID NO:7, (iii) a protein comprising an amino acid sequence that has at least 75% identity with an amino acid sequence set forth in SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6 or SEQ ID NO:7 or (iv) *Arabidopsis* C3H polypeptide ortholog, wherein said isolated DNA or fragment thereof is capable of increasing anthocyanin content, and
- b. regenerating said plant from said transformed plant cells.

5. A method of decreasing cell wall bound conjugates in a plant, comprising:

- a. transforming plant cells with an isolated DNA comprising a nucleic acid or its complement operably linked in either sense or antisense orientation to at least one regulatory sequence, wherein said nucleic acid comprises a nucleotide sequence coding for (i) *Arabidopsis* C3H comprising an amino acid sequence set forth in SEQ ID NO:4 or SEQ ID NO:6, (ii) mutant c3h comprising an amino acid sequence set forth in SEQ ID NO:5 or SEQ ID NO:7, (iii) a protein comprising an amino acid sequence that has at least 75% identity with an amino acid sequence set forth in SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6 or SEQ ID NO:7 or (iv) *Arabidopsis* C3H polypeptide ortholog, wherein said isolated DNA or fragment thereof is capable of decreasing cell wall bound conjugates, and
- b. regenerating said plant from said transformed plant cells.

6. The method of claim 5, wherein the conjugates are selected from the group consisting of ferulic acid, sinapic acid and combinations thereof.
7. A method of altering phenylpropanoid metabolism in a plant, comprising:
- a. infecting plant cells with a virus vector comprising a fragment of nucleic acid or its complement operably linked in either sense or antisense orientation to at least one regulatory sequence, wherein said nucleic acid comprises a nucleotide sequence coding for (i) *Arabidopsis* C3H comprising an amino acid sequence set forth in SEQ ID NO:4 or SEQ ID NO:6, (ii) mutant c3h comprising an amino acid sequence set forth in SEQ ID NO:5 or SEQ ID NO:7, (iii) a protein comprising an amino acid sequence that has at least 75% identity with an amino acid sequence set forth in SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6 or SEQ ID NO:7 or (iv) *Arabidopsis* C3H polypeptide ortholog, wherein said isolated DNA or fragment thereof is capable of altering phenylpropanoid metabolism, and
  - b. regenerating said plant from said transformed plant cells, wherein the effect of altered phenylpropanoid metabolism is selected from the group consisting of: altered content or composition of lignin, increased flavonoid content, increased isoflavonoid content, increased anthocyanin content, decreased cell wall bound conjugates and combinations thereof.
8. A plant transformed by the method of claim 1.
9. A plant transformed by the method of claim 2.
10. A plant transformed by the method of claim 3.
11. A plant transformed by the method of claim 4.
12. A plant transformed by the method of claim 5.
13. A plant transformed by the method of claim 7.
14. A method for producing transgenic plants comprising:

- a. transforming plant cells with an isolated DNA comprising a nucleic acid or its complement, said nucleic acid comprises a nucleotide sequence selected from the group consisting of:
- (i) a nucleotide sequence coding for mutant *Arabidopsis* p-coumarate 3-hydroxylase (c3h) comprising an amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7;
  - (ii) a nucleotide sequence coding for a protein comprising an amino acid sequence that has at least 90% identity with an amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7;
  - (iii) a nucleotide sequence coding for all or a substantial portion of the amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7;
  - (iv) a nucleotide sequence that is substantially similar to an isolated nucleic acid molecule coding for all or a substantial portion of the amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7; and
  - (v) a nucleotide sequence that hybridizes with one of the nucleotide sequences of (a)-(d) under the following hybridization conditions: 40% formamide, with 6X SSC, 0.1X SSC, at 55°C and washed with 2X SSC, 0.1% SDS followed by 0.1X SSC, 0.1% SDS;
- with the proviso that said nucleic acid does not encode for *Arabidopsis* nucleotide sequence of SEQ ID NO:1, and
- b. selecting transformed plant cells containing said DNA, and
- c. regenerating said transgenic plant from said transformed plant cells.

15. An isolated DNA comprising a nucleic acid or its complement, said nucleic acid comprises a nucleotide sequence coding for a member selected from the group consisting of:
- a. mutant *Arabidopsis* c3h comprising an amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7;
  - b. a protein comprising an amino acid sequence that has at least 90% identity with an amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7; and
  - c. all or a substantial portion of the amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7,

with the proviso that said nucleic acid does not encode for Arbidopsis nucleotide sequence of SEQ ID NO:1.

16. The isolated DNA of claim 15, wherein said nucleic acid comprises a nucleotide sequence selected from the group consisting of:

- a. SEQ ID NO:2; and
- b. the complement of SEQ ID NO:2.

17. The isolated DNA of claim 15, wherein said nucleic acid comprises a nucleotide sequence or its complement selected from the group consisting of:

- a. a nucleotide sequence that has at least 90% identity with the nucleotide sequence of SEQ ID NO:2;
- b. a nucleotide sequence that is substantially similar to an isolated nucleic acid molecule coding for all or a substantial portion of the amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7; and
- c. a nucleotide sequence that hybridizes with one of the nucleotide sequences of (a) or (b) under the following hybridization conditions: 40% formamide, with 6X SSC, 0.1X SSC, at 55°C and washed with 2X SSC, 0.1% SDS followed by 0.1X SSC, 0.1% SDS,

with the proviso that said nucleic acid does not encode for Arbidopsis nucleotide sequence of SEQ ID NO:1.

18. A vector comprising the isolated DNA of claim 15.

19. A vector comprising the isolated DNA of claim 16.

20. A transformed plant cell comprising the isolated DNA of claim 15 or a fragment thereof capable of altering phenylpropanoid metabolism.

21. A transformed plant comprising the isolated DNA of claims 15, or fragment thereof which is capable of altering phenylpropanoid metabolism.

22. An isolated polypeptide comprising an amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7.

23. Host cells transformed with a DNA molecule comprising a nucleotide sequence selected from the group consisting of:

a. a nucleotide sequence coding for a member selected from the group consisting of:

- (i) mutant *Arabidopsis* c3h comprising an amino acid sequence selected from the group selected from SEQ ID NO:5 and SEQ ID NO:7;
- (ii) a protein comprising an amino acid sequence that has at least 90% identity with an amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7; and
- (iii) all or a substantial portion of the amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7;

b. SEQ ID NO:2; and

c. the complement of SEQ ID NO:2.

d. a nucleotide sequence that has at least 90% identity with the nucleotide sequence of SEQ ID NO:2;

e. a nucleotide sequence that is substantially similar to an isolated nucleic acid molecule coding for all or a substantial portion of the amino acid sequence selected from the group consisting of SEQ ID NO:5 and SEQ ID NO:7; and

f. a nucleotide sequence that hybridizes with one of the nucleotide sequences of a. through e. under the following hybridization conditions: 40% formamide, with 6X SSC, 0.1X SSC, at 55°C and washed with 2X SSC, 0.1% SDS followed by 0.1X SSC, 0.1% SDS,

with the proviso that said nucleic acid does not encode for *Arbidopsis* nucleotide sequence of SEQ ID NO:1.

24. A method of producing a polypeptide which comprises:

- a. culturing the host cells of claim 23 under conditions suitable for the production of said polypeptide; and
- b. recovering said polypeptide.

25. A plant comprising the nucleic acid sequence of SEQ ID NO:2 or fragment thereof.

26. A mutant plant or plant cell comprising the nucleic acid of SEQ ID NO:2, wherein said plant or plant cell is identified by a method selected from the group consisting of: (a) transfer DNA tagged identification and (b) transposon mutagenesis identification.